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Comparative Analysis of ICT Accessibility and Usability of Korean Students Based on PISA 2015 and 2018 Data

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Abstract

The OECD surveys the questionnaire on the background of ICT every three years since 2003. In this study, we compare and analyze the changes in ICT accessibility and ICT usability of Korean students in 2015 and 2018 using the ICT background data of OECD PISA. ICT accessibility refers to the degree of access to ICT equipment at school or at home. There are 10 items of accessibility surveys at schools used by PISA, and 11 items at home. ICT usability refers to how much ICT equipment is used at or outside of school for learning or non-learning purposes. There are ten items for surveying usability at school, and twenty-four items for surveying usability outside of school. In the analysis of this study, the arithmetic mean of the items is used. As a result, Korean students' accessibility at school improved from 25.48% in 2015 to 40.40% in 2018, and from the lowest group in 2015 to below-average group in 2018. In terms of students' usability at school, we analyzed the percentage of students who use the ICT equipment 'almost every day' and the students who use it 'everyday'. Both 2015 and 2018 are among the lowest. Accessibility at home is higher in 2018 than in 2015, and belongs to the average group of OECD countries in 2018. ICT Usability for learning purposes outside of school is the lowest group in both 2015 and 2018. ICT Usability outside of school for non-learning purposes is in the average group of OECD countries. As a result of this study, we can see that Korea's digital literacy education is weak compared to other OECD countries. Prior to education about the Fourth Industrial Revolution, investment in digital literacy education is needed.

Keywords: *OECD, PISA, ICT equipment, ICT Accessibility, ICT Usability, Digital Literacy*

1. Introduction

OECD countries publish a variety of statistics to set the direction of the world's economy, industry and education. In the field of education, they investigate and present mathematical, scientific, and problem solving skills. They are also investigating students' various background knowledge, one of which is the background knowledge of Information Communication and Technology (ICT).

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Every three years since 2003, the OECD surveys students in OECD countries about their ICT background. The survey was conducted in 2003, 2006, 2009, 2012, 2015 and 2018 [1-6]. Since the survey reflects changes in ICT technology, the survey items have changed over the years[7], and the results of the six surveys cannot be simply compared. In order to apply the education method for the Fourth Industrial Revolution[8], it is important to first understand the ICT status of Korean students compared to other countries. Looking at the 2015 survey items and the 2018 survey items, there were little changes in the survey items on ICT accessibility and usability[9]. Therefore, it is meaningful to analyze the change by comparing the data of these two years.

The purpose of this study is to analyze changes in ICT accessibility and usability of Korean students. We study the PISA's 2018 ICT background survey data from OECD countries published in December 2019 and compare this data with the 2015 data. In Chapter 2, we discuss survey items for identifying ICT accessibility and usability both at school and out of school. In Chapter 3, we analyze ICT accessibility and usability of Korean students compared to other OECD countries based on 2015 and 2018 PISA data, and in Chapter 4, we make a conclusion.

2. Survey Items

2.1 ICT Accessibility at School

The ICT accessibility survey items at school determine whether students have free access to ICT equipment at school. The survey items for 2015 and 2018 are the same. There are ten PISA 2018 survey items, as shown in Table 1, each with a code[10].

Table 1. ICT accessibility survey items for use at school

Code	Survey items
SA1	Desktop computer
SA2	Portable laptop or notebook
SA3	Tablet computer
SA4	Internet connected school computers
SA5	Internet connection via wireless network
SA6	Storage space for school-related data
SA7	USB (memory) stick
SA8	e-book reader
SA9	Data projector
SA10	Interactive whiteboard

For each of the 10 survey items in Table 1, students can answer one of the following:

- Yes, and I use it
- Yes, but I don't use it
- No

2.2 ICT Usability at School

The survey items on ICT usability at school are about whether students are free to use ICT equipment in various activities at school. There are ten ICT usability survey items in 2018 and nine in 2015 except for SU10. The PISA 2018 survey items are shown in Table 2 and each has a code[10].

Table 2. ICT usability survey items for use at school

Code	Survey items
SU1	<Chatting on line> at school
SU2	Using email at school
SU3	Browsing the internet for schoolwork
SU4	Downloading, uploading or browsing material from the school's website
SU5	Posting my work on the school's website
SU6	Posting simulations at school
SU7	Practicing and drilling, foreign language learning or math
SU8	Doing homework on a school computer
SU9	Using school computers for group work and communication with other students
SU10	Using learning apps or learning websites

For each of the 10 survey items in Table 2, students can answer one of the following:

- Never or hardly ever
- Once or twice a month
- Once or twice a week
- Almost every day
- Everyday

2.3 ICT Accessibility Outside of School

Survey items examine whether students have free access to ICT equipment outside of school (home). The survey items for 2015 and 2018 are the same. There are eleven PISA 2018 survey items, each with a code as shown in Table 3[10]. Students can answer questions about each of the 11 survey items in Table 3 with the same options as in the ICT accessibility survey at school, described in Section 2.1.

Table 3. ICT accessibility survey items for use at home

Code	Survey items
HA1	Desktop computer
HA2	Portable laptop or notebook
HA3	Tablet computer
HA4	Internet connection
HA5	Video game
HA6	Cell phone (without internet access)
HA7	Cell phone (with internet access)
HA8	Portable music player
HA9	Printer
HA10	USB (memory) stick
HA11	e-book reader

2.4 ICT Usability Outside of School

ICT usability survey items determine whether students are free to use ICT equipment outside of school for

a variety of activities. There are 24 survey items, the same for both 2018 and 2015. Table 4 shows the survey items used to examine ICT usability for learning purposes outside of school[10].

Table 4. ICT usability survey items for use outside of school (learning purpose)

Code	Survey items
HLU1	Browsing the internet for schoolwork
HLU2	Browsing the internet to follow up lessons, e.g. for finding explanation
HLU3	Using email for communication with other students about schoolwork
HLU4	Using email for communication with teachers and submission of homework
HLU5	Using social networks for communication with other students about schoolwork
HLU6	Using social networks for communication with teachers
HLU7	Downloading, uploading or browsing material from the school's website
HLU8	Checking the school's website for announcements, e.g. absence of teachers
HLU9	Doing homework on a computer
HLU10	Doing homework on a mobile device
HLU11	Using learning apps or learning websites on a computer
HLU12	Using learning apps or learning websites on a mobile device

Table 5 shows ICT usability survey items for use outside of school for non-learning purposes[10].

Table 5. ICT usability survey items for use outside of school (non-learning purpose)

Code	Survey items
HU1	Playing one-player games
HU2	Playing collaborative online games
HU3	Using email
HU4	Chatting online (e.g. <MSN>)
HU5	Participating in social networks (e.g. <Facebook>, <Myspace>)
HU6	Playing online games via social networks (e.g. <Farmville>, <The Sims Social>)
HU7	Browsing the Internet for fun (such as watching videos, e.g. <YouTube>)
HU8	Reading news on the Internet (e.g. current affairs)
HU9	Obtaining practical information from the Internet
HU10	Downloading music, films, games or software from the Internet
HU11	Uploading your own created contents for sharing
HU12	Downloading new apps on a mobile device

Students can respond to questions on each of the 24 survey items in Table 4 and Table 5, with the same options as in the ICT usability survey at school, described in Section 2.2.

3. Analysis

In Chapter 3, we analyze ICT accessibility and usability based on data surveyed by students from member countries of the OECD PISA in 2015 and 2018. As of 2018, a survey of 15-year-old students from 37 countries was conducted. The sampling method is described in the PISA report [5]. As of 2018, the weighted number of 15-year-old Korean students surveyed was 455,544, of which 0.79% was missing data. Excluding the missing

data, the valid weighted number of students surveyed was 451,959.

3.1 Analysis of ICT Accessibility at School

Table 6 shows the OECD average and Korean students' accessibility to ICT equipment in schools based on statistics from the 2018 and 2015 OECD PISA.

Table 6. ICT accessibility at school

	year	SA1 (%)	SA2 (%)	SA3 (%)	SA4 (%)	SA5 (%)	SA6 (%)	SA7 (%)	SA8 (%)	SA9 (%)	SA10 (%)	average (%)	rank
OECD	2018	56.75	36.35	23,10	67.57	53.69	52.61	31.01	9.59	59.00	40.47	40.70	
	2015	47.88	25.13	14.81	55.90	43.96	44.39	27.00	6.29	48.46	31.68	34.55	
Korea	2018	62.46	30.95	21.61	72.37	43.83	48.02	38.06	11.59	53.11	22.04	40.40	22(31)
	2015	47.10	14.56	6.52	55.12	26.13	30.55	21.04	4.81	36.14	12.81	25.48	29(30)

In Table 6, *average* refers to the average of 10 survey items with no item weights. In 2015, the average accessibility of Korean students was 25.48%, which was the lowest among the 30 OECD countries, except Japan. This is much lower than the OECD average of 34.55%. The 2015 data show that all 10 survey items are below the OECD average. In the 2018 data, the OECD average is 40.70%, and Korea is 40.40%, which is the 22nd out of 31 OECD countries. There are four survey items with Korean students' ICT accessibility higher than the OECD average in 2018: desktop computers, internet-connected computers, USB, and e-book readers. Items below the average are the data projectors and interactive whiteboards used in the class.

In terms of accessibility of ICT equipment in schools, Korea was in the lowest group in 2015 and in the below-average group in 2018.

3.2 Analysis of ICT Usability at School

Table 7 shows the OECD average and Korean students' usability of ICT equipment in schools based on statistics from the 2018 and 2015 OECD PISA.

Table 7. ICT usability at school

	2015						2018					
	Almost every day			everyday			Almost every day			everyday		
code	Korea (%)	rank	OECD (%)	Korea (%)	rank	OECD (%)	Korea (%)	rank	OECD (%)	Korea (%)	rank	OECD (%)
SU1	4.41	31	12.10	2.09	31	11.91	4.50	30	14.78	3.45	30	15.18
SU2	1.10	31	6.22	0.59	31	4.22	2.14	29	8.29	1.32	29	5.84
SU3	2.77	30	11.02	1.09	30	6.60	4.51	29	14.22	2.41	29	9.76
SU4	1.44	30	5.88	0.84	30	3.82	2.72	29	8.44	1.97	29	5.59
SU5	0.81	30	3.22	0.49	30	2.58	1.72	29	5.63	1.31	29	4.12
SU6	0.74	31	3.29	0.41	31	2.41	1.75	30	5.30	1.21	30	3.50
SU7	2.17	30	5.92	1.04	30	3.34	2.89	29	8.18	1.65	29	4.69
SU8	1.54	29	5.15	0.89	29	3.39	2.94	29	7.66	1.79	29	5.28
SU9	1.33	30	4.98	0.67	30	3.45	2.93	29	7.36	1.72	29	4.81
SU10							2.80	29	7.42	1.74	29	5.07
average	1.81		6.42	0.90		4.63	2.89		8.78	1.86		6.38

In Table 7, *average* refers to the average of the survey items for the 'almost every day' and 'everyday' responses without weighting the items. Comparing the average value of nine items in 2015, 'almost every day' was 1.81% and 'everyday' was 0.90%, both of which are much lower than the OECD average. In the 2018 10-item average, 'almost every day' is 2.89% and 'everyday' is 1.86%, much lower than the average for OECD countries.

In terms of the usability of ICT equipment in schools, Korea was in the lowest group in 2015 and also in the lowest group in 2018.

3.3 Analysis of ICT Accessibility Outside of School

Table 8 shows the OECD average and Korean students' accessibility of ICT equipment outside of school (home), based on statistics from the 2018 and 2015 OECD PISA.

Table 8. ICT accessibility at home

	year	HA1 (%)	HA2 (%)	HA3 (%)	HA4 (%)	HA5 (%)	HA6 (%)	HA7 (%)	HA8 (%)	HA9 (%)	HA10 (%)	average (%)	rank
OECD	2018	55.15	70.21	50.53	90.23	50.81	28.51	90.02	42.65	60.47	69.96	60.85	
	2015	49.65	61.42	44.76	77.67	40.51	25.32	75.53	47.48	54.81	63.79	54.09	
Korea	2018	66.47	62.18	43.98	91.83	34.96	29.65	94.84	40.99	66.62	76.79	60.83	17(31)
	2015	63.26	44.59	25.99	88.44	21.73	28.85	90.47	50.03	61.58	60.88	53.58	28(30)

In the 2015 data, ICT accessibility at home is 53.58% in Korea, ranking 28th out of 30 countries, which is among the lowest in OECD countries. In 2018, Korea has 60.83%, the OECD average is 60.85%, and Korea ranks 17th among 31 countries. In 2018, Korea belongs to the average group of OECD countries. ICT accessibility at home has improved for three years in Korea.

3.4 Analysis of ICT Usability Outside of School

The use of ICT equipment by students outside of school can be categorized as used for school-related purposes and for general activities. In this study, we analyze the cases used for learning and the cases not for learning purposes.

First, a survey of the use of ICT equipment for school work in outside of school was conducted on 12 survey items in 2018 and 2015. Table 9 lists the percent (Korea), ranking, and OECD average of students responding with 'almost every day' and 'everyday' for each category.

Table 9. ICT usability outside of school (learning purpose)

	2015						2018					
	Almost everyday			everyday			Almost everyday			everyday		
code	Korea (%)	rank	OECD (%)	Korea (%)	rank	OECD (%)	Korea (%)	rank	OECD (%)	Korea (%)	rank	OECD (%)
HLU1	7.36	29	14.07	2.30	30	7.09	12.08	19	14.96	5.22	27	8.09
HLU2	5.61	30	11.44	1.63	30	5.70	10.33	23	13.20	4.46	26	6.93
HLU3	3.90	29	7.65	1.39	31	4.74	7.42	20	8.94	4.18	24	5.84
HLU4	2.69	27	5.61	1.13	29	3.51	6.43	19	7.92	3.44	27	4.93
HLU5	12.10	28	16.81	9.12	28	16.04	16.37	25	18.96	15.67	20	17.71
HLU6	4.46	23	5.68	3.09	28	5.89	7.99	14	7.96	7.37	13	7.14

HLU7	3.30	29	8.31	1.41	30	5.67	7.09	28	10.62	4.51	27	7.07
HLU8	7.04	23	9.68	3.03	27	7.40	10.29	19	12.38	6.86	20	8.96
HLU9	5.70	29	11.54	2.18	28	6.86	11.43	14	13.39	6.28	18	8.83
HLU10	5.47	27	7.35	1.59	30	4.60	10.05	16	10.57	5.67	19	6.68
HLU11	3.26	27	4.89	1.37	29	3.70	7.69	21	9.68	4.62	22	6.13
HLU12	2.12	28	4.30	0.94	29	3.45	7.89	21	9.97	4.73	25	6.66
average	5.25		8.94	2.43		6.22	9.58		11.55	6.08		7.91

In Table 9, *average* refers to the average of the survey items for the 'almost every day' and 'everyday' responses without weighting the items. In 2015, out-of-school ICT usability for learning purposes averaged 5.25% for 'almost every day' and 2.43% for 'everyday', both lower than the OECD average. We can see that Korea is the lowest group. In 2018, Korean students' ICT usability at home for learning purposes was 9.58% for 'almost every day' and 6.08% for 'everyday'. This is much lower than the average for OECD countries, which is still a lower group.

The percentage of Korean students using ICT equipment for learning purposes outside of school was the lowest group in 2015, and slightly higher in 2018, but also the lower group.

Second, a survey of the use of ICT equipment outside of school for non-learning purposes was conducted on 12 items in 2015 and 2018. Table 10 shows the percentage (Korea), ranking, and OECD average of students responding with 'almost every day' and 'everyday'.

Table 10. ICT usability outside of school (non-learning purpose)

	2015						2018					
	Almost everyday			everyday			Almost everyday			everyday		
code	Korea (%)	rank	OECD (%)	Korea (%)	rank	OECD (%)	Korea (%)	rank	OECD (%)	Korea (%)	rank	OECD (%)
HU1	11.13	27	12.29	4.32	31	8.59	14.69	21	15.87	8.83	28	11.31
HU2	10.25	28	19.71	4.13	31	10.79	17.80	2	14.57	10.60	29	14.34
HU3	3.62	31	13.01	2.11	31	9.32	7.46	31	14.52	4.29	31	10.97
HU4	15.54	26	16.80	21.02	30	34.36	21.57	5	17.4	63.04	6	49.82
HU5	25.27	3	17.86	40.34	25	42.89	19.20	11	16.80	54.78	12	49.17
HU6	13.20	1	6.39	8.46	14	7.17	9.60	12	8.85	12.05	8	10.20
HU7	32.91	1	24.02	22.54	31	36.65	27.31	2	23.52	50.98	11	47.47
HU8	18.41	23	19.04	9.23	31	16.83	19.34	21	20.19	15.82	24	18.59
HU9	14.30	30	19.04	5.67	31	12.56	21.09	14	20.80	14.93	17	16.11
HU10	20.49	21	18.77	12.61	30	17.11	19.11	23	19.84	19.78	22	21.63
HU11	5.60	27	7.38	3.85	30	6.86	6.23	26	8.67	6.04	28	8.92
HU12	9.09	30	12.22	4.57	31	9.72	10.14	21	11.98	8.79	24	11.12
average	14.98		15.54	11.57		17.74	16.13		16.08	22.49		22.47

In 2015, ICT usage for non-learning purposes was 14.98% for 'almost every day' and 11.57% for 'everyday' at home. 'Almost every day' is slightly lower than the average in OECD countries, and 'everyday' is much lower than the average in OECD countries. Korean belongs to the lower group. In 2018, 'almost every day' is 16.13% and 'everyday" is 22.49%, close to the average of OECD countries.

The percentage of using ICT equipment for non-learning purposes outside of school was in lower group in 2015 and the median group in 2018.

4. Conclusion

In this study, we analyzed ICT accessibility and usability of Korean students in comparison with OECD countries using PISA's ICT background data from 2018 and 2015.

In terms of ICT accessibility in schools, Korea is the lowest group in 2015 and below-average group in 2018. In terms of ICT usability in schools, Korea is the lowest group in 2015 and also the lowest group in 2018. In terms of ICT accessibility at home, in 2015, Korea ranked 28th out of 30 countries, which was in the lowest group of OECD countries. In 2018, it belongs to the OECD average group.

The results of ICT usability analysis in case of outside of school for learning purposes are: in 2015, it is among the lowest. In 2018, Korea still belongs to the lower class. As a result of usability analysis for non-learning purposes outside of school, Korea is in lower group in 2015, and in average group in 2018.

Improvements in 2018 over 2015 are 'ICT accessibility at school', 'ICT accessibility at home', and 'ICT usability outside of school for non-learning purposes'.

In the twenty-first century, Korea has been promoting national plans to introduce the fourth industrial revolution and artificial intelligence into school classes. However, as a result of this study, we can see that the national index of digital literacy in Korea is very low in comparison with OECD countries. Therefore, digital literacy education should be done prior to the 4th industrial revolution or artificial intelligence education.

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